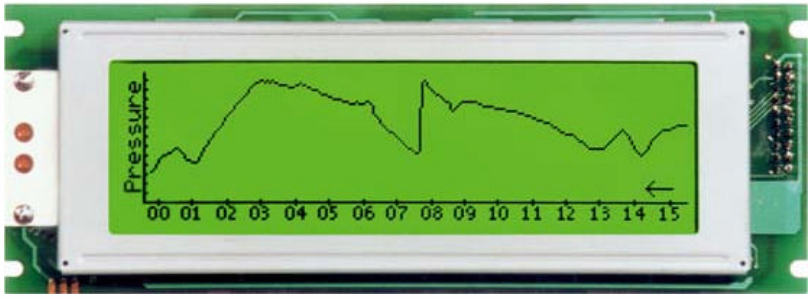
Matrix Orbital Corporation

GLC24064

USER MANUAL



Connecting The GLC24064

The GLC24064's Serial Inteface has two types of communications: RS-232 and I²C.

Regular Voltage

Power is applied to the white or brown four pin SIP connector as follows:

Pin 1: +5V DC
Pin 2: = SCL (I²C clock)
Pin 3: = SDA (I²C data)
Pin 4: Gnd

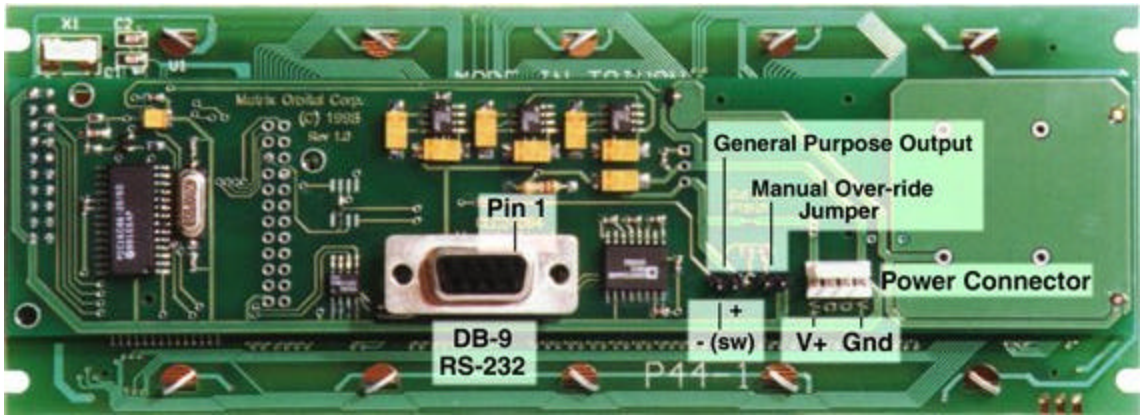
If the sole data source is via RS - 232, the data input is via the DB9 connector. Pins 2 and 3 are not used.

Wide Voltage with Efficient Switching Power Supply (VPT)

Power is applied to the white or brown four pin SIP connector as follows:

Pin 1: +8 - 30Vdc
Pin 2: = SCL (I²C clock)
Pin 3: = SDA (I²C data)
Pin 4: Gnd

If the sole data source is via RS - 232, the data input is via the DB9 connector. Pins 2 and 3 are not used.



Warning:

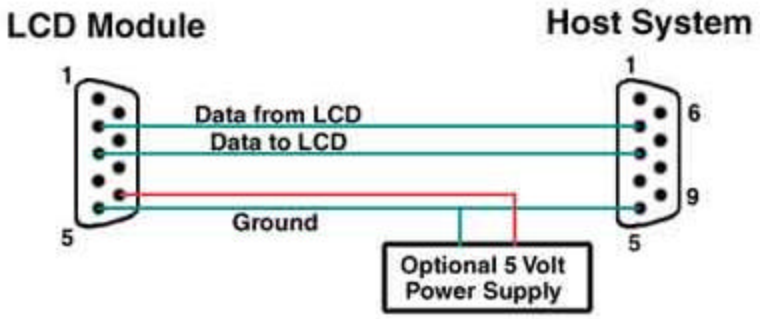
Do not apply any power with reverse polarization.
Do not apply an voltage other than the specified voltage.
Do not use any cables other than the cables supplied by Matrix Orbital, unless you are aware of the modifications required.
Do not under any circumstances use an unmodified floppy drive power cable.

DB9 Connector Pin Out

RS - 232 port: This connector is wired so that a standard "straight through" 9 pin D-sub cable may be used to connect the modules on a standard serial port such as comm ports on PCs. Note that this device complies to the EIA232 standard in that it uses signal levels from +/- 3V to +/- 12V. It will not operate correctly at TTL (0 to +5V) levels.

Pin Number	Description
2	Data Out
3	Data In
5	Ground
9	+5Vdc

Note: Signals are shown as interpreted by the Liquid Crystal Display module.



Power may be provided to the module by pin 9 of the DB9 connector instead of through the 4-pin SIP. If power is to be applied using the DB9, it must be a regulated 5Vdc supply. If the user intends to use pin 9 as the power source, then the user must solder the 5 volt jumper point beside the DB9 connector. If you have any further questions or concerns please don't hesitate to contact Matrix Orbital.

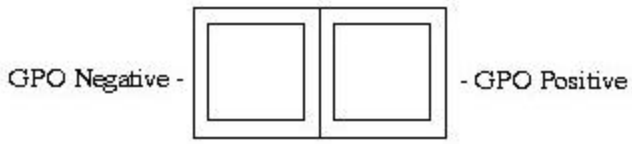
WARNING: USE THIS METHOD OF POWER UP AT YOUR OWN RISK. APPLICATION OF A VOLTAGE TO PIN 9 GREATER THAN 5.5VOLTS WILL CAUSE IMMEDIATE DESTRUCTION OF UNIT AND VOID THE WARRANTY.

Note: This applies to wide voltage units(VPT extensions) as well as to standard 5 volt units.

General Purpose Output (GPO)

The GPO is meant to be used as a pair. The positive side of the GPO is connected to a power source of +5Vdc supplied by the module at 20mA. The negative side of the GPO is capable of finding a path to ground through a 240 ohm resistor. This resistor will limit the current flow through a GPO to approximately 20mA in the event of a short circuit. If the device which is being driven by a GPO requires a relatively high current (such as a relay) and has an internal resistance of it's own greater than 250 ohms, then the 240 ohm resistor may be shorted. You will find this resistor directly below the negative pin of the general purpose output.

Note: This operation requires soldering. The GPO does not have any over current or over/under voltage protection so care must be taken if the user decides to connect the negative side differently. For instance if the external device is a relay it must be fully clamped to absorb any generated back electro-motive force (EMF).



Fonts, Bitmaps and the File System

Matrix Orbital graphic modules contain a sophisticated file system for storing and retrieving font information, bitmaps and system parameters: Not unlike the way that a computer deals with files on a hard drive. However, the modules use no moving parts, therefore, data is stored far more reliably than data on a home PC.

Operationally, there is one important difference between the Matrix Orbital file system and that of a PC. While a PC will allow fragmentation of its files across the available file space, the Matrix Orbital file system takes great care to ensure that all parts of a file are stored together. This system works well to maximize storage space and operational efficiency, however, during file downloads, the modules may need to spend considerable time moving files to make room for the new file. This delay during download can be as much as a minute, but generally it will not exceed 10 seconds.

When a file is being downloaded with the same "name" or reference number as previously existing file, the old file needs to be deleted first. Since we cannot know if the new file is exactly the same size as the old file, that space vacated by the old files filled by moving previously existing files down to fill up the vacated space. This ensures that no file space is wasted.

Of course, the average module will simply have files loaded into it and it will then get to work, without ever having to perform this file reorganization task. The file space may be rewritten up to 100 000 times, but most users will simply load in their fonts and bitmaps once and that will be it.

The Matrix Orbital Interface program mogd.exe which is provided on the disk and the website generates and downloads fonts larger than 14 pixels in height.

To make use of smaller fonts it is recommended that you use a pre-generated font. You will find these fonts on the disk or the website. Unfortunately, integrating these fonts is not as straight forward as generating the fonts yourself. To make use of these fonts you must place the font files in your font directory as defined in the interface program. You can find and define this directory under settings. A font file consists of a single file with an extension .mgf and a directory which contains bitmaps for every character. All .mgf files are contained within the font directory and all bitmap directories are sub directories of the font directory. After download of the font file use a “Zip” program to “UnZip” the .mgf file and bitmap sub-directory into your font directory. Start or restart the interface program and push the font tab. You should now see your new pre-generated font listed in the font list.

Command Set

Basic Operation

The operation of the GLC24064 is simple and user friendly. By transmitting commands listed within this section of the manual the user is able to display text, graphics, and primitives. The user can also alter the screen or behavior of the GLC by transmitting certain commands.

Writing Text to the Display

When the display receives a character, it then displays that character at the current position. The next character sent to the module then advances to the following position on the display. Characters are drawn using the currently selected font, and only characters defined by the current font are actually processed. Characters that are not defined by the current font are ignored, and the positioning is not advanced for the next character.

The position where text is to be displayed is a single pixel location stored in the GLC's volatile memory and maintained internally by the GLC's firmware. It can be manually manipulated with two commands. One command positions the characters using a text oriented coordinate system, dividing the display into character cells. The other command positions the character at a specific pixel, allowing more "fine grained" control when needed.

Commands

To access the GLC's features and use the command set the user must sent a command prefix byte followed by a command byte. Some commands require parameters, and are not executed until all parameters are received. Others require no additional information and are executed immediately when received.

The command prefix is the single byte 0xFE (decimal 254). Sending the command prefix to the GLC instructs it to await another byte containing the command that needs to be executed. When the GLC receives the command byte, it will either act on the command immediately if parameters are not necessary, or will wait for more data if parameters are required.

Contained within the command set of the GLC24064 are basic commands, advanced commands, and graphic commands. Basic commands include instructions such as "Set Current Text Position", "Clear Display", and "Set Contrast" along with various other primary commands. The advanced commands provide access to more complex features, such as "Set Font Metrics" and "Set RS-232 Port Speed" the functions of these types of commands are usually management of graphics, memory, configuration and fonts. The graphics command section of the command set covers areas that are mainly limited to graphics displays. "Draw Line", "Draw Rectangle" and "Display Saved Bitmap" are examples of these specialized commands.

Basic Commands

All commands are prefixed by the command 0xFE, Hex FE, Decimal 254

Auto Line Wrap On
ASCII 'C', Hex 43, Decimal 67
Syntax 0xFE 0x43

This command enables the automatic line wrap function. Transmitted characters which overrun the width of the display will automatically wrap to the next line. The bottom line wraps to line 1 of the display. To carry out this command the user must send a command prefix followed the character 'C'.

Auto Line Wrap Off
ASCII 'D', Hex 44, Decimal 68
Syntax 0xFE 0x44

This command disables the automatic line wrapping function. To turn off the the auto line wrapping, send a command prefix followed by the character 'D'.

Auto Scroll On
ASCII 'Q', Hex 51, Decimal 81
Syntax 0xFE 0x51

To turn the automatic line scrolling on, send a command prefix followed by the character 'Q'. In combination with the "Auto Line Wrap" command the text will automatically wrap and scroll up.

Note: "Auto Line Wrap" must be enabled for "Auto Scroll" to work properly.

Auto Scroll Off
ASCII 'R', Hex 52, Decimal 82
Syntax 0xFE 0x82

To turn the automatic line scrolling off, send a command prefix followed by the character 'R'.

Clear Display
ASCII 'X', Hex 58, Decimal 88
Syntax 0xFE 0x58

To clear the screen of the GLC, send a command prefix followed by the character 'X'. This command clears the display and resets the text write position to the top left of the screen.

Set Contrast
ASCII 'P', Hex 50, Decimal 80
Syntax 0xFE 0x50 <contrast>

This command sets the display's contrast to <contrast>, where <contrast> is a value between 0x00 and 0xFF (between 0 and 255). Lower values cause "on" elements in the display area to appear lighter, while higher values cause "on" elements to appear darker. Lighting conditions will affect the actual value used for optimal viewing. Individual GLC modules will also differ slightly from each other in appearance. In addition, values for optimal viewing while the GLC backlight is on may differ from values used when backlight is off.

Set Contrast and Save Value
Hex 91, Decimal 145
Syntax 0xFE 0x91

This command works in exactly the same way as the "Set Contrast" command. The only difference is it saves the contrast value in the memory of the module, whereas, the previous command only changes the value for the duration of use.

Backlight On
ASCII 'B', Hex 42, Decimal 66
Syntax 0xFE 0x42 <minutes>

To turn the backlight on, send a command prefix followed by the character 'B', followed by a value defining the amount of time the backlight will remain on. This command turns on the backlight, it requires the time in , this specifies how long the backlight will remain on after receipt of the command. If is zero (0), the backlight will remain on indefinitely. Note: backlight is always on by default on power up.

Backlight Off
ASCII 'F', Hex 46, Decimal 70
Syntax 0xFE 0x46

This command turns the backlight of the GLC off.

Set Current Text Position
ASCII 'G', Hex 47, Decimal 71
Syntax 0xFE 0x47 <column> <row>

This command sets the cursor position to the <column> and <row> specified. This command positions the cursor using the base size of the current font (this command does not position the cursor at a specific pixel). The pixel column used is determined by multiplying the width of the widest character in the font by <column>. The pixel row used is determined by multiplying the height of the font by <row>. If precise pixel-based cursor positioning is required, refer to the "Set Current Text Position (Graphic)" command below.

Set Current Text Position to Top Left
ASCII 'H', Hex 48, Decimal 72
Syntax 0xFE x48

This command moves the cursor to the top left of the display area, based on the metrics of the current font. Refer to the "Set Font Metrics" command below for more details.

General Purpose Output On
ASCII ‘V’, Hex 56, Decimal 86
Syntax 0xFE 0x56

To turn the general purpose output on, send a command prefix followed by the character ‘V’.

General Purpose Output Off
ASCII ‘W’, Hex 57, Decimal 87
Syntax 0xFE 0x57

To execute this command, send a command prefix followed by the character ‘W’.

Advanced Commands

Set Current Font
ASCII '1', Hex 31, Decimal 49
Syntax 0xFE 0x31 <font identifier>

This command instructs the GLC to use the font specified by <font identifier> as the default font. The value specified should refer to a font already present in the GLC's memory.

Set Font Metrics
ASCII '2', Hex 32, Decimal 50
Syntax 0xFE 0x32 <left margin> <top margin> <x space> <y space> <scroll row>

This command defines the metrics of a font already present in the GLC's memory. <left margin> specifies the first pixel column to user for the first character in a row. In some instances, a font may not evenly fit on the screen, and dividing the extra space between the margins will improve the overall appearance of the font. <top margin> specifies the top pixel row to begin drawing the first row of text on the display area. <x space> specifies the number of pixels to place between characters (i.e. line spacing). <y space> specifies the number of pixels to place between rows of text (i.e. line spacing). <scroll row> specifies the pixel row where scrolling should start (or, if auto scrolling is off, where wrapping should occur).

Set I²C Address
ASCII '3', Hex 33, Decimal 51
Syntax 0xFE 0x33

To write the I²C address of the module, send a command prefix followed by the character '3', followed by a write address. This command sets the I²C write address of the module. This value must be an even number and the read address is one higher. For example if the I²C write address is set to 0x50, then the read address is 0x51. The change in address is immediate. This address is 0x50 by default, and is reset temporarily back to that value when the "Manual Over-ride" jumper is used on power up. Refer to the Appendix for more details.

Set Serial Number
ASCII '4', Hex 34, Decimal 52
Syntax 0xFE 0x34 <serial number byte one> <serial number byte two>

To set the serial number of the module, send a command prefix followed by the character '4', followed by two values defining the first and second serial byte. This command sets the two byte serial number of the module. Upon the execution of this command, the module will echo these two bytes back over the RS-232 interface. The serial number may be set only once. Any future attempt to execute this command will result in no change and the module will return to the originally set serial number.

Read Serial Number
ASCII '5', Hex 35, Decimal 53
Syntax 0xFE 0x35

To read the serial number, send a command prefix followed by the character '5'. This command will return, over the RS-232 interface, the serial number of the module as it was previously stored.

Read Version Number
ASCII '6', Hex 36, Decimal 54
Syntax 0xFE 0x36

To read the version number send a command prefix followed by the character '6'. This command will return, over the RS-232 interface, the firmware revision number of the module as it is stored.

Read Module Type Value
ASCII '7', Hex 37, Decimal 55
Syntax 0xFE 0x37

To read the module type value, send a command prefix followed by the character '7'. This command will return, over the RS-232 interface, the model type value of the module. Values for various modules at the time of this publication are as follows:

LCD0821 – 0x01	LCD2021 – 0x03	LCD1641 – 0x04
LCD2041 – 0x05	LCD4021 – 0x06	LCD4041 – 0x07
LK202-25 – 0x08	LK204-25 – 0x09	LK404-55 – 0x0A
VFD2021 – 0x0B	VFD2041 – 0x0C	VFD4021 – 0x0D
VK202-25 – 0x0E	VK204-25 – 0x0F	GLC12232 – 0x10
GLC12864 – 0x11	GLC128128 – 0x12	GLC24064 – 0x13
GLK12864-25 – 0x14	GLK24064-25 – 0x15	GLK128128-25 – 0x21
GLK12232-25 – 0x22	LK404-AT – 0x31	VFD1621 – 0x32
LK402-12 – 0x33	LK162-12 – 0x34	LK204-25PC - 0x35

Set RS232 Port Speed
ASCII '9', Hex 39, Decimal 57
Syntax 0xFE 0x39 <speed>

This command sets the GLC's RS232 port to the specified <speed>. The change takes place immediately. <speed> is a single byte specifying the desired port speed. Valid speeds are shown in the table below. The GLC can be manually reset to 19,200 baud in the event of an error during transmission (including transmitting a value not listed below) by setting the "manual override" jumper on the GLC controller board during power up. This command is ignored until this jumper is removed again. Refer to appendix for details.

Speed Value	Speed
20 Hex	9600 baud
0F Hex	19200 baud
95 Hex	57600 baud
03 Hex	76800 baud
8A Hex	115000 baud

Erase File
ASCII '-', Hex B0, Decimal 176
Syntax 0xFE 0xB0

To erase a file within the GLC memory, send a command prefix followed by the character '-', followed by the type of file and the reference number corresponding to that file within the GLC memory. This command erases a single file at a time. This command needs to be given two parameters. First the user must define what type of file it is . There are two types of files, fonts <0x01> and bitmaps <0x05>. Then the user must define the reference number of the file in the GLC memory . Once this command is completed all files "move up" and recover the empty space for efficient memory management.

Memory Purge
ASCII '!', Hex 21, Decimal 33
Syntax 0xFE 0x21 0x59 0x21 (!Y!)

This command completely erases the GLC's non-volatile memory. This removes all fonts, font metrics, bitmaps, and settings (current font, cursor position, communication speed, etc.). It is an "odd" command in that it is three bytes in length. This is to prevent accidental execution.

Graphics Commands (all lower case)

Set Drawing Color
ASCII 'c', Hex 63, Decimal 99
Syntax 0xFE 0x63 <color>

This command sets the drawing color for subsequent graphic commands that do not have the drawing color passed as a parameter. The parameter <color> is the value of the color where white 0 Hex, and black is 255 Hex.

Draw Line
ASCII 'l', Hex 6C, Decimal 108
Syntax 0xFE 0x6C <color> <x1> <y1> <x2> <y2>

This command will draw a line using color <color> from (<x1>,<y1>) to (<x2>,<y2>). This command will not alter the global drawing color set by the 'c' command. Lines may be drawn from any part of the display to any other part, but may be important to note that the line may interpolate differently right to left, or left to right. This means that a line drawn in white from right to left may not fully erase the same line drawn in black from left to right.

Continue Line
ASCII 'e', Hex 65, Decimal 101
Syntax 0xFE 0x70 <x> <y>

This command will draw line with the current drawing color from the last line end (<x2>,<y2>) to (<x>,<y>). This command uses the global drawing color so the 'c' command should be used before the first line segment if required.

Put Pixel
ASCII 'p', Hex 70, Decimal 112
Syntax 0xFE 0x70 <x> <y>

This command will draw a pixel at (<x>,<y>) using the current drawing color

Draw Rectangle
ASCII 'r', Hex 72, Decimal 114
Syntax 0xFE 0x72 <color> <x1> <y1> <x2> <y2>

This command will draw a solid rectangle using color <color> from (<x1>,<y1>) to (<x2>,<y2>) (bottom right).

Draw Square
ASCII ‘x’, Hex 78, Decimal 120
Syntax 0xFE 0x78 <color> <x1> <y1> <x2> <y2>

To draw a square, send a command prefix followed by the character ‘x’. The user must then specify the <color> of the square and the position of the square on the GLC screen. The position of the square is set by pixels (<x1>,<y1>) being the top left and (<x2>,<y2>) being the bottom right. This command will draw a solid square.

Initialize Bar Graph
ASCII 'g', Hex 67, Decimal 103
Syntax 0xFE 0x67 <reference number> <type> <x1> <y1> <x2> <y2>

This command initializes a bar graph referred to by number <reference number> of type <type> with size from (<x1>,<y1>) (top left) to (<x2>,<y2>) (bottom right). A maximum of 16 bar graphs with reference numbers from 0 to 15 can be initialized as:

Vertical bottom referenced (<type> = 0)
Vertical top referenced (<type> = 2)
Horizontal left referenced (<type> = 1)
Horizontal right referenced (<type> = 3)

The bar graphs may be located anywhere on the display, but if they overlap, they will not display properly. Note: it is important that <x1> is less than <x2>, and <y1> is less than <y2>.

Write to Bar Graph
ASCII 'i', Hex 69, Decimal 105
Syntax 0xFE 0x69 <reference number> <value>

This command sets the bar graph <reference number> to value <value>

Direct Screen Write Bitmap
ASCII 'd', Hex 64, Decimal 100
Syntax 0xFE <x1> <y1> <x2> <y2> <data> [<data>]

This command is used to draw a bitmap to the screen directly without first storing it in the file space. This is a far quicker method of drawing a bitmap to the screen than using individual pixels. There are some irregularities and limitations to this command.

Unlike the format of bitmap download, this command expects data to be sent horizontally instead of vertically. The first byte of data is located in the top left of the are defined by (<x1>,<y1>) and the MSB of that byte is the leftmost pixel. The second byte is then next 8 pixels to the right of the first byte. While each individual byte is oriented as you would expect with LSB toward the right and the bytes moving from left to right across the screen, it is not a "bit-stream" as could be expected. After the first pixel row of data is sent, data continues on the next pixel row.

The definition of <x1> and <x2> must lie on "byte boundaries". That is , <x1> and <x2> must be defined as 0x00, 0x08, 0x10, etc. It is not possible to write a 10 x 10 bitmap to the screen at pixel location (13,13). It is possible to write a 16 x 10 bitmap to the screen at pixel location (24,13) however.

Initialize Strip Chart
ASCII ‘j’, Hex6A, Decimal 106
Syntax 0xFE 0x6A <reference> <x1> <y1> <x2> <y2>

To initialize a strip chart the user must send a command prefix followed by the character ‘j’. The user must then define an area on the display in which to place the strip chart. <x1> <y1> is the top left corner of the area to be used, where <x1> is the placement of the column where the strip chart is to begin and <y1> is the row. The user must then define <x2> being the bottom right column of the area to be utilized and <y2> is the bottom right row. This allows the user to define an area on the GLC screen for a strip chart.

The definition of and must lie on "byte boundaries". That is, and must be defined as 0x00, 0x08, 0x10, etc.

Shift Strip Chart
ASCII ‘k’, Hex 6B, Decimal 107
Syntax 0xFE 0x6B <reference>

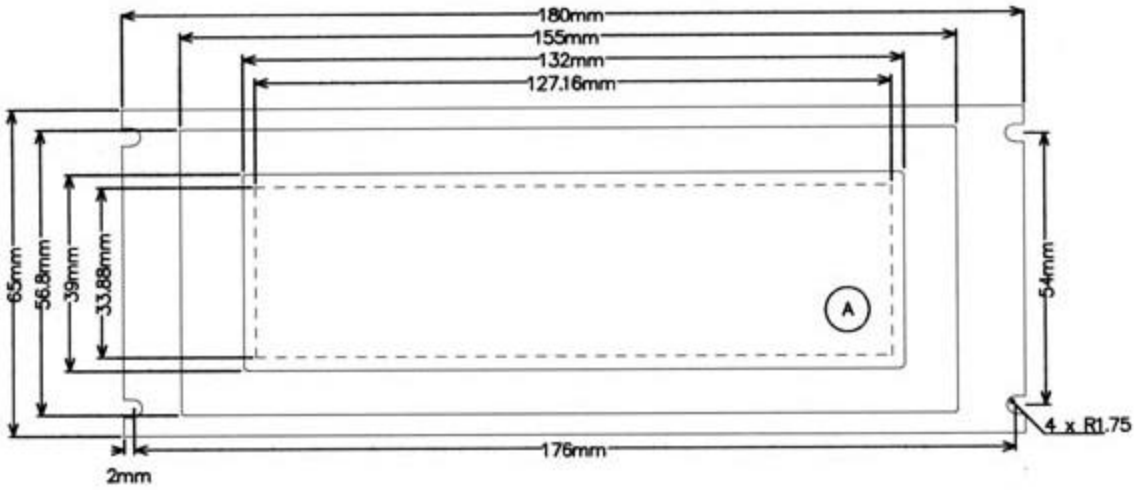
This command shifts the strip chart. To enable this command the user must send a command prefix followed by the character 'k' and followed by a reference number defining the direction in which the chart will shift. <reference> is the direction the chart will be flowing. To shift the chart to the right the value would be 0x01 to shift the chart to the left the value would be 0x00. This command shifts the contents of the area defined in the "Initialize Strip Chart" command 8 pixels at a time. There is continuous shifting of the area when this command is activated.

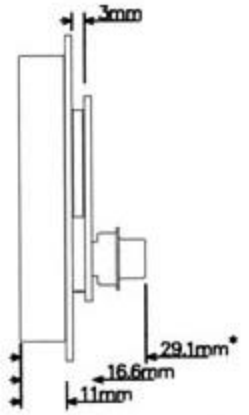
Specification Sheets

Environmental Specifications	
	Standard Temperature
Operating Temperature	-20ºC to +70ºC
Storage Temperature	-30ºC to +80ºC
Operating Relative Humidity	90% Max Non - Condensing
Vibration (Operating)	4.9 m/s2 XYZ Directions
Vibration (Non-Operating)	19.6 m/s2 XYZ Directions
Shock (Operating)	29.4 m/s2 XYZ Directions
Shock (Non-Operating)	490 m/s2 XYZ Directions

Electrical Specifications (Ta = 25ºC, Vin = 5V)	
Supply Voltage	4.75 - 5.25 Vdc (Optional 7 -30Vdc)
Supply Current	31 mA typical
Backlight Supply Current	160 mA typical

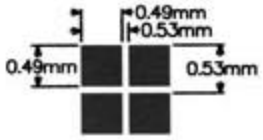
Optical Characteristics	
Pixel Layout	240 pixels x 64 pixels XxY
Number of Characters	320 Characters (maximum 40 Characters x 8 Lines w/ 5x7 font)
Display Area	127.16mm x 33.88mm XxY
Dot Size	0.49mm x 0.49mm (XxY)
Dot Pitch	0.53mm x 0.53mm (XxY)
LED Backlight Life	100 000 hours typical
Color of Illumination	Yellow Green





* Max depth 20.6mm
without connectors

Detail A



Appendix

Hex numbers are specified in C language convention as 0xUL - where U is the upper nibble and L is the lower nibble. E.g.: 0xFE is 1111 1110 in binary. This is equivalent to ULH or ULh as in the binary number.

1111	1110
Upper Nibble	LowerNibble

This would be FEH or FEh.

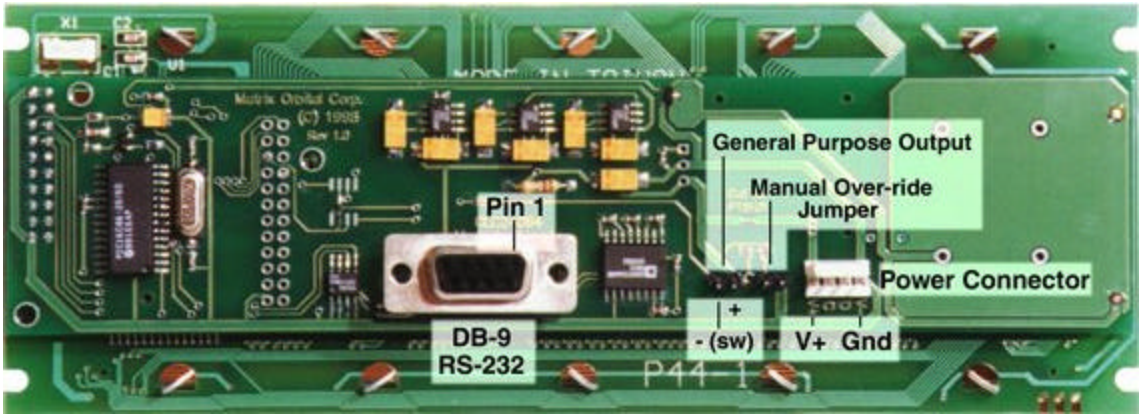
Manual Override

Manual override should only be required in one instance. If for some reason the module is set at a baud rate which cannot be produced by the host system and all communication to the display is lost, then the user should follow this simple procedure:

1) Turn off the display
2) Put a jumper on the Manual Over-ride Jumper as indicated in Figure 2.
3) Power up the display.
4) Remove the jumper and change the RS-232 port settings to a baud rate recognized by the host system.
5) Turn off the display.
6) Power up the display.

Refer to the "Set RS-232 Port Speed" command in the command set section for acceptable baud rates.

Figure 2



NORTH AMERICA

CANADA

HVW Technologies
Suite 473, 300 - 8120 Beddington Blvd. N.W.
Calgary, Alberta T3K 2A8 Canada
Telephone: +1 403 730 8603
Facsimile: +1 403 730 8903
Email: info@hvwtech.com
WWW: http://www.hvwtech.com/

Tri-M Systems Inc.
6-1301 Ketch Court
Coquitlam, BC V3K 6X7 Canada
Toll Free Telephone: 1 800 665 5600
Alternate Telephone: +1 604 527 1100
Facsimile: +1 604 527 1110
Email: info@tri-m.com
WWW: http://www.tri-m.com/

UNITED STATES

EMJ Embedded Systems
Suite 100-1434 Farrington Road
Apex, North Carolina 27502 USA
Toll Free Telephone: 1 800 436 5872
Facsimile: +1 919 363 4425
Email: sales@emjembedded.com
WWW: http://www.emjembedded.com/

Jameco Electronic Components
1355 Shoreway Road
Belmont, California 94002-4100 US
Toll Free Telephone: 1 800 831 4242
Toll Free Facsimile: 1 800 237 6948
Email: sales@jameco.com
WWW: http://www.jameco.com/

SPECIAL NOTE: Currently only carries LCD2041, LK204-25

Linux Central
Suite T2 37060 Garfield
Clinton Township, Michigan 48036 USA
Telephone: +1 810 226 8200
Toll Free Telephone: 1 877 LINUX CD (546 8923)
Facsimile: +1 810 226 8600
Email: sales@linuxcentral.com
WWW: http://linuxcentral.com/

EUROPE

AUSTRIA

MEGATON Ges.m.b.H.
Franz-Schubert-Gasse 12, A-2372 GIESSHÜBL
Telephone : +43 0 2236 43179
Facsimile : +43 0 2236 4317921
Email: oesterreich@elektronikladen.de

FINLAND

Symmetric Oy
Maria Jotunin Tie 11
Helinski, Finland 00400
Telephone: + 358 9 5885 322
Facsimile: + 358 9 5885 578
Email: symmetric@symmetric.fi
WWW: http://www.symmetric.fi/

GERMANY

Elektronikladen Mikrocomputer Gmbh
Offices throughout Germany
Telephone : +49 0 5232 8171
Facsimile : +49 0 5232 86197
Email: sales@elektronikladen.de
WWW: http://www.elektronikladen.de/

THE NETHERLANDS

Antratek Electronics
Kanaalweg 33,
NL-2903LR Capelle aan den Ijssel, The Netherlands
Telephone : +31 10 4504949
Facsimile : +31 10 4514955
Email: info@antratek.nl
WWW: http://www.antratek.nl

ITALY

QuadriviumNET
Via Circonvalazione Sud, 76
33033 Codriopo, Udine, Italy
Telephone : +39 0 432 906062
Facsimile : +39 0 432 901514
Email: info@qnet.it
WWW: http://www.qnet.it/

SCANDINAVIA

Lawicel
Klubbgatan 3
SE-282 32 Tyringe, Sweden
Telephone: +46 0 451 598 77
Facsimile: +46 0 451 598 78
Email: info@lawicel.com
WWW: http://www.lawicel.com

Lilla Fabriken
Box 1003
SE-172 21 Sundbyberg, Sweden
Telephone: +46 8 287 286
Facsimile: +46 8 288 802
Email: info@lillfab.se
WWW: http://www.lillfab.se

SWITZERLAND

Bernhard Elektronik
Aarauer Str. 20,
CH-5734 Reinach AG
Telephone : +41 0 62 7716944
Facsimile : +41 0 62 7716944
Email : schweiz@elektronikladen.de

MIDDLE EAST

ISRAEL

Alpha Terminals & Printers Ltd.
7 Ha'Mifalm St.
Petach - Tikva, Israel 49250
Telephone: +972 3 9214422
Facsimile: +972 3 9219966
Email: alpha99@ibm.net

AUSTRALIA

AUSTRALIA

Alfa-Tek
Unit 7, 42 - 50 Stud Road
Bayswater, Victoria, Australia, 3111
Telephone: + 61 39 720 5344
Facsimile: + 61 39 720 5268
Email: will@alfatek.com.au
WWW: http://www.alfatek.com.au/

ASIA

INDIA

AL Systems
105, 3rd Street,
Tatabad, Coimbatore - 641012
Tamil Nadu, India
Telephone: +91-422-233166, 493960
Facsimile: +91-422-230958, 213849
Email: also@vsnl.com
WWW:http://business.vsnl.com/al_systems

AFRICA

EGYPT

AmGroup 13
Sheraton Heliopolis
Zone 8, Cairo EGYPT
Email: amgrou@link.com.eg

Contact Information

To request information or purchase any of Matrix Orbital Corporation's products please contact one of our Authorized Distributors. For technical questions and support please contact us.

Sales/Accounts	Chantelle Jenkins
	cjenkins@matrix-orbital.com
Technical Support	Aman Sidhu
	support@matrix-orbital.com
Lead Project Engineer	Rob Hansen
	rhansen@matrix-orbital.com

Tel: (403) 229-2737 Fax: (403) 229-1963

Or visit us at our website: http://www.matrix-orbital.com

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